MILL SECTION of

Concrete

Vol. 29 October, 1926 No. 4

170,000,000 Barrels

THE year 1925 was a six billion dollar building year. In that year 156,000,000 barrels of cement were actually used, though approximately 161,000,000 barrels were produced. This allowed only a conservative margin of excess stock for emergency demand.

Nineteen twenty-six will exceed 1925 in volume of construction and there is every indication that cement shipments for the year will run up to a new record total of around 170,000,000 barrels. In round numbers, there is an increase of about 10,000,000 barrels in cement shipments each year. The present year promises to more than supply its quota.

Present operating plants have an estimated production capacity of about 200,000,000 barrels and this will be substantially increased when plants now building come into production. In addition, many of the older plants are engaged in increasing their capacity.

An examination of the plans for many of the new cement mills now under construction reveals the confidence of the industry in its continued future expansion. Practically every layout is planned with definite provisions for the expansion of the original plant. Space is provided for new kilns and other machinery often up to double the capacity of the initial new installation.

The confidence of the cement manufacturers in the steady continued growth of shipments seems warranted by the continued growth of construction volume and by the increasing favor in which portland cement is being held as a building material.

The saturation point of construction volume seems as elusive as the saturation point in automobile construction. Yet the fact that there must be a limit to our construction program is generally believed by students of the building industry. That a nation can exhaust itself in construction is shown by the experiences of Egypt during the pyramid age. Something of a similar nature has occurred recently in France in the rebuilding of the devastated regions.

To the extent that reinforced concrete construction reduces costs and employs new methods and new materials, it relieves the construction industry and helps to stave off saturation. It is in the change from other types of construction to concrete, that the cement manufacturers will find their increasing markets rather than in tremendous increases in the volume of building construction generally.

High Early Strengths

EVIDENCES everywhere point to the fact that there is developing an unmistakable demand for high early strength cements. Engineers talk about it, cement companies advertise the short time forms need to be in place and roads can be opened to traffic when special precautions are taken with ordinary portland cement, the newspapers are discussing it, and the subject generally is very much in the limelight.

Most of those who demand that type of cement have in all probability only a very rudimentary idea of just what the term implies. The one thing they do know is that they want to strip forms and load structures just as quickly as possible.

Manufacturers of cement are not ignoring this demand. It may reasonably be concluded that concrete design and concrete workmanship are yet too far behind the progress made in cement manufacture to make this new demand reasonable. It may be accepted as true that the present standard of cement is a better cement than many contractors know how to use to its best advantage. Granting all these conditions, the fact remains that the builder is impatient of the delays incident to the hardening of concrete and expects the cement manufacturer to help him out of that difficulty.

The remedy will not necessarily be new or better cements. It is possible that the campaigns for greater skill in the use of the standard cements that are now under way, combined with more thought in the planning of schedules and more attention to the principles of concrete design will meet the need.

It has been contended that cement, like steel, will ultimately be supplied in several grades with different standards for various classes of work. That analogy does not apply to cement for, by varying his mixes and changing his methods slightly, the contractor can make concrete of various strengths. Class A, B and C concrete have long been known.

But whether these variations are of sufficient extent to meet present-day demands remains to be seen. European cement manufacturers were forced to provide special cements that attained the high early strengths the users demanded and revised their manufacturing and marketing policies to meet that demand. Their experiences may point the way to future development in the American cement industry.

Southwestern Portland Cement Company Makes Good at Osborn

More Than a Year of Operation Proves Efficiency of the Plant—High Grade of Cement Produced—Electrical Quarry Operation—Plant Equipment Includes Foreign Machinery—Well Equipped Laboratory—Dust Reclamation—Service Laboratory Installed—Manufacturing Processes Described

On June 24, 1925, the first car of "Miami" cement left the Osborn, Ohio, plant of the Southwestern Portland Cement Company. Much had been claimed for this cement and much was expected of it, for the new plant was the fulfillment of a long standing ambition of Carl Leonardt, the president of the company. The other plants of the Southwestern Portland Cement Company at Victorville, Calif., and at El Paso, Texas, had long been considered as among the best in the industry, but the new plant at Osborn was to be the best that could be designed and was to have the finest equipment that, in the opinion of the builders, could be purchased.

The Osborn plant has been in operation now for a little over a year and the results justified the expectations. Built of reinforced concrete throughout, with beautiful grounds and attractive auxiliary buildings, the first impression of the plant is most favorable. The inside of the plant is as spick and span as the grounds. Efficient dust collecting installations keep the interior of the buildings exceptionally clean. While the plant covers a large area, it is compactly and logically laid out. A new office building and laboratory have just been completed and the entire grounds are being landscaped. Mr. Leonardt believes that a factory can be beautiful as well as efficient.

As to the material produced, the accompanying chart of average tests made from cement shipments for March, 1926, tells the story. Careful attention to proportioning, raw grinding, burning and clinker grinding produces a cement that attains unusual high strengths.

Quarry Electrically Operated

Changes from gasoline drills and from steam shovels to electrically operated equipment have reduced quarrying costs substantially. When the quarry was first opened, one Marion No. 61 steam shovel and one Marion No. 125 electric shovel were used. The Marion No. 125 has been replaced by a new Marion No. 37 electric, full revolving shovel with 1.8 cubic yard capacity dipper. Direct current is used. The steam shovel required five men for operation, while the electric shovel requires only two men.

Two electrically operated Loomis klipper drills, drilling holes 6 inches in diameter and 35 feet deep, replaced the gasoline drills formerly used.

The substitution of electrical equipment in the quarry has resulted in greater convenience and lower costs. Less labor is required. There is no need to haul fuel for shovels

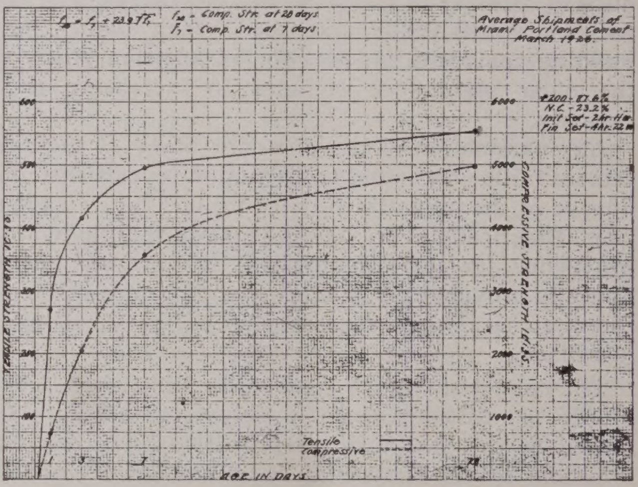
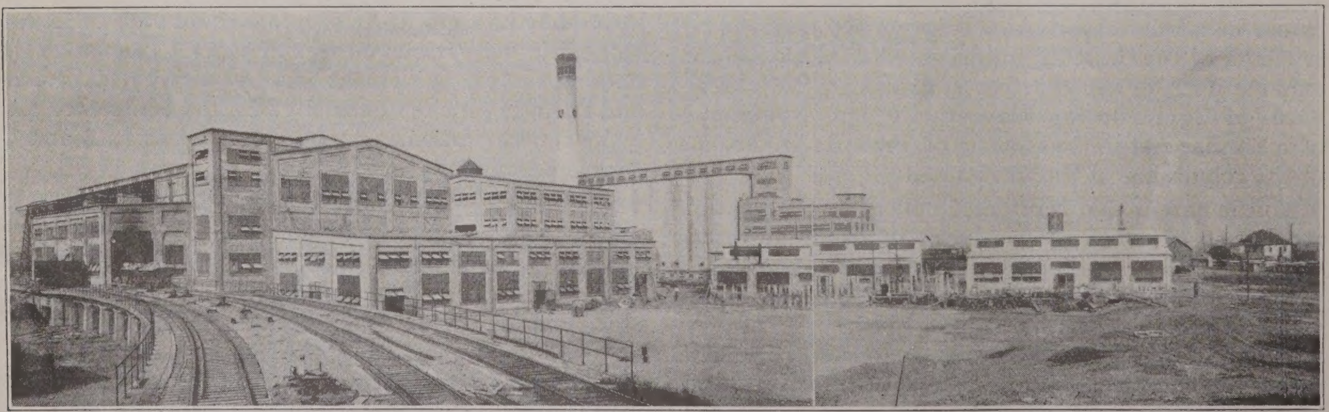
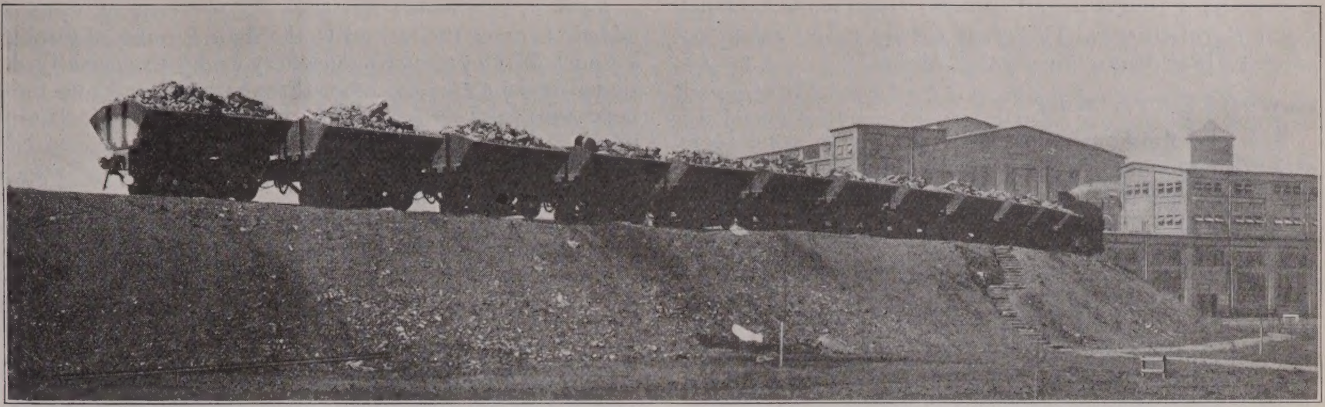


Chart showing results of tests from average shipments of Miami portland cement during March, 1926. Solid line, tensile strength; dotted line, compressive strength



General view of the plant. The new laboratory and office building have since been completed



A load of rock from the quarry

or drills. Power cost is practically eliminated, as the electricity used is generated by the waste-heat boilers at the plant.

The quarry is approximately a mile and a half from the plant and is connected with it by means of a standard gauge railway. The face of the quarry is about 1600 feet long and 35 feet high.

Stone is hauled from the quarry to the plant in 12-ton Koppel cars. Thirty-six of these are in use. Three Vulcan 52-ton, side rod locomotives and one 56-ton Shay, geared type locomotive, pull the cars between the quarry and the plant. Shale comes from Zanesfield, Ohio, about 60 miles away and is shipped in standard railroad cars.

Crushing Plant

The mill is a wet process plant with a 4,500 barrel capacity. Provisions are made for increasing the capacity to 6,000 barrels.

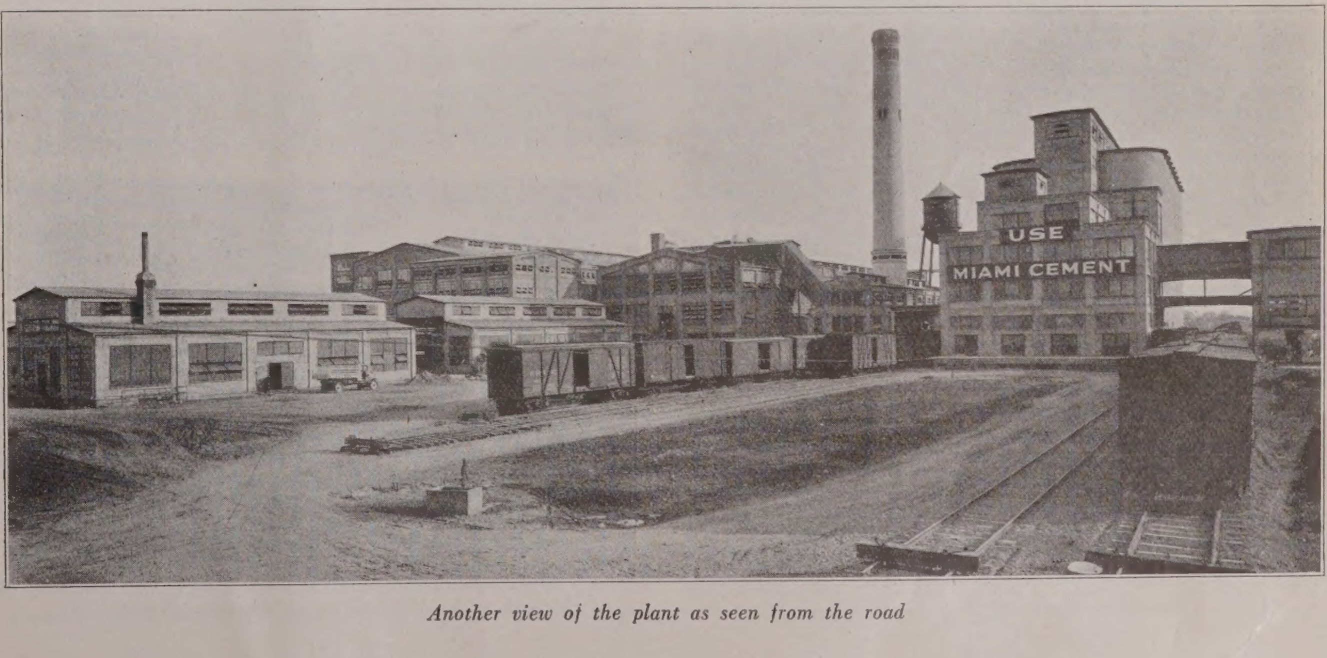
The raw materials are dumped from cars placed on sidings on a concrete trestle approach to the mill. Movement of the cars on the siding is entirely automatic. A 1¼-inch cable operating on a single drum Thomas hoist, gear-connected to a 50-hp. motor, pulls the cars along the track and spots them at the hoppers. An overhead hoist tips the cars, discharging the stone into one of the two hoppers. Shale cars dump into a special hopper near the stone hoppers. The shale is then conveyed to one of the crushers.

The quarry size rock is crushed in one of two special hammer crushers to 1 or 1½ inch size. There are two shafts on each crusher, each shaft being driven by a 100-hp. motor through a 40-inch Cutler-Hammer magnetic clutch. The crushers in use at the Osborn plant are the largest of this type ever built by this company. They are capable of crushing from 200 to 250 tons of quarry size rock to tube mill feed size per hour.

An interchangeable arrangement of conveyor and elevator permits the use of either or both crushers for rock or for shale. The materials from both crushers can be sent either to the bins feeding the raw mills or to storage. The materials from No. 1 crusher can be discharged either to an elevator feeding directly to storage or they can be discharged onto a pan conveyor leading to a 54-inch Jeffrey elevator of special design which discharges onto any one or both of two specially designed shuffle conveyors. These conveyors, also the largest ever built by the manufacturers, extend in duplicate from the elevator to the storage bins and the raw mill bins. This arrangement makes it possible to send material from either crusher to either the raw mill bins or to storage.

The shuffle conveyor mentioned is used in several other parts of the mill, the locations to be described later. They have proved very satisfactory. They require little power for operation, are low in upkeep and are perfectly safe. They are suitable only for conveying the coarser materials such as crushed rock or clinker.

Raw material storage is 100 by 400 feet in size. The entire area is covered and the materials are moved from

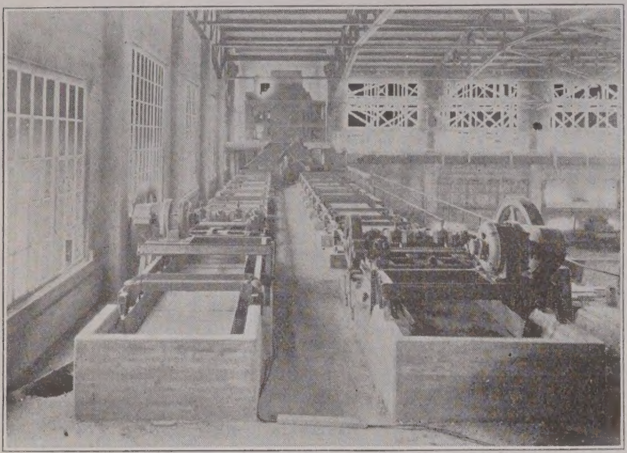


Another view of the plant as seen from the road storage by a 16,000 pound capacity crane made by Pawling & Harnischfeger. The crane carries a 150 cubic foot capacity Blaw-Knox "Speedster" bucket.

Raw and Clinker Mills

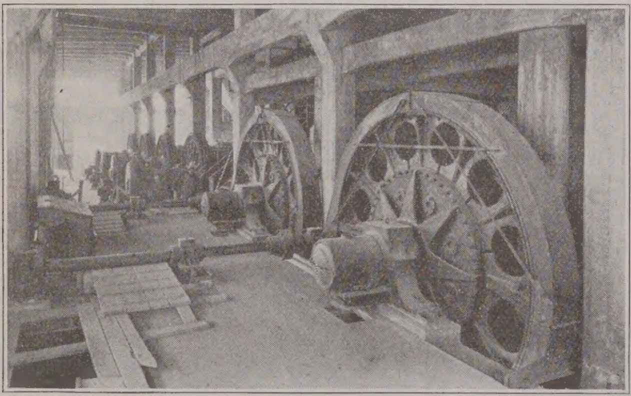
Raw and finish grinding mills are in the same room, all mills and motors being in alignment.

Especial attention is paid to raw grinding. All material leaving the raw mill is ground so that 92 per cent or more passes the 200-mesh screen. There are five mills for raw grinding and four for clinker grinding. All of the raw mills and one of the clinker mills are of the same make as the shuffle conveyor and the hammer crushers. The raw mills are 3-compartment mills, 26 feet long with diameters of 7 feet 6 inches in the preliminary compartments and 5 feet 11 inches in the second and third compartments, while the finish department mill is 40 feet long. Each mill has a capacity of 50 barrels per hour and it pulverizes stone 1½ inches in size or clinker as it comes from the kiln to the finished fineness.



"Torpedo conveyor" over the raw mills

The two other mills on the clinker end are standard 7 by 26-foot "compeb" units, manufactured by the Allis-Chalmers Company. The raw mills are driven by 400-hp. synchronous motors through 60-inch Cutler-Hammer magnetic clutches. The clinker mills are driven by 500-hp. motors through the same type clutches.



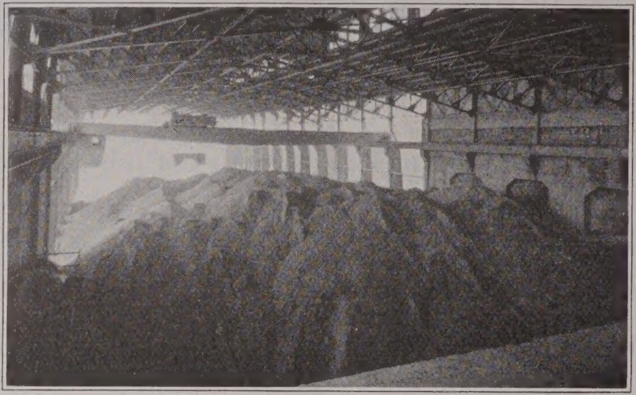
The mill building showing the raw and finish mills

Feeders of special design feed the stone to the raw mills. They are of the revolving table type with the revolving disk set on an incline as shown in an accompanying illustration. The feeders are driven by a 2-hp. motor through a D. O. James Mfg. Co. speed reducer. The design permits accurate regulation of the volume of material fed to the mills.

As the shale enters the mill, 55 per cent of water is added. Leaving the raw mills, the shale is pumped through a 6-inch Wilfley centrifugal slurry pump to specially designed tanks above the other three raw mills. From these tanks the slurry is fed to the mills through a 6-inch pipe line.

Blending

Two specially designed air-lift pumps convey the slurry from an underground sump to the blending and storage tanks. There are 15 tanks—3 rows of 5 each—the first two rows of which are used for blending. The tanks are of reinforced concrete, 23 feet in diameter and 37 feet deep. Each tank has a capacity of 1200 barrels. A unique method of keeping the slurry agitated is used.



Rock and shale storage

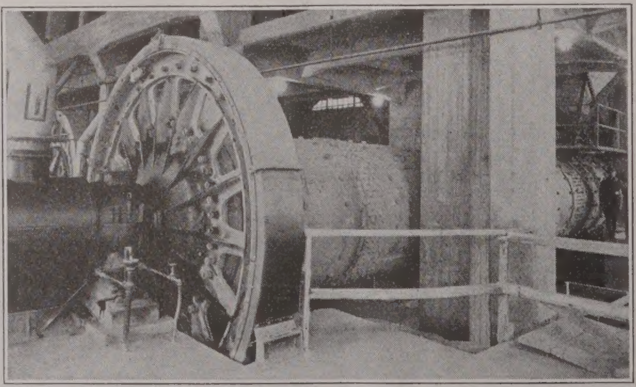
Kilns

Kilns, also, are of special design. Two of the three in service were manufactured by the Allis-Chalmers Company and the other one by the Traylor Engineering and Manufacturing Company. Extreme care is exercised in burning and the clinker is uniformly small, the maximum size being about half an inch.

The kilns are 175 feet long and 10 feet in diameter except the burning zone, which is 11 feet 6 inches in diameter. There is a full seal both on the feed and the discharge ends of the kilns to increase the heat at the front end of the kiln and to permit accurate burning. The required amount of air for combustion is supplied by the waste-heat boiler fan. Heat is conserved by cutting down the infiltration of air from other sources.

Coal Room

A feature of the coal room is its cleanliness. Dryers and mills are equipped with Clark dust collectors which provide clean, safe operating conditions and conserve coal by

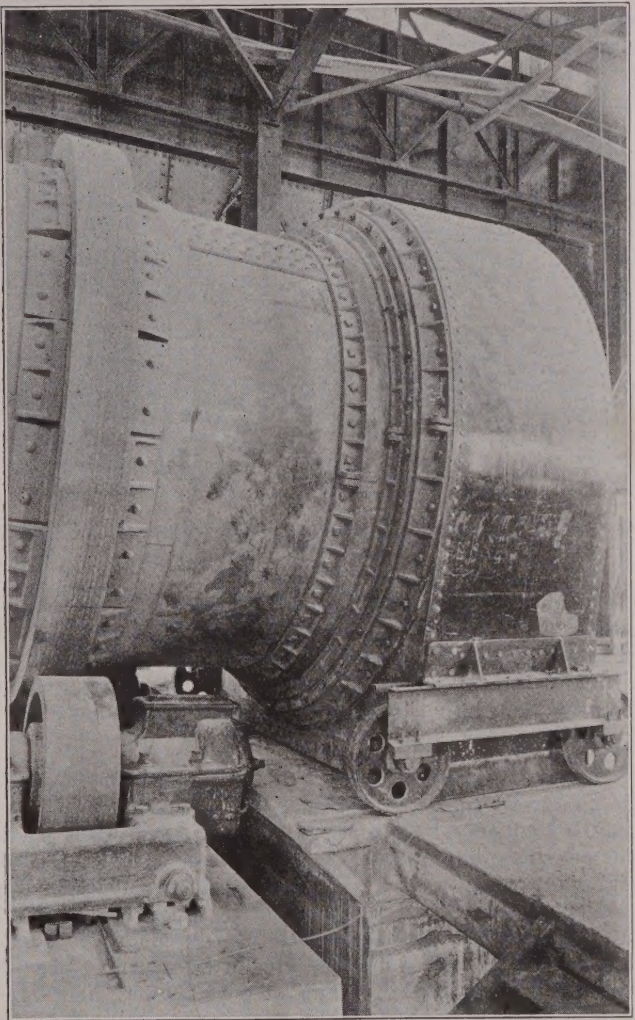


A 7 by 40 foot finish compartment mill. This is the first mill of this size to be installed in an American cement mill eliminating waste. More than 95 per cent of the dust is reclaimed.

The coal is fed through Randolph dryers (Fuller-Lehigh Co.) by gravity from the raw coal storage bins after which it enters the mills. The dryers are of the stationary type and utilize waste heat from the kilns and the cooler housings. Two 8-inch Fuller-Kinyon pumps convey the pulverized coal from the coal mills to the storage bins over the kiln burning floor and over the auxiliary boilers. The installation uses full automatic control as well as hand control.

Waste Heat Boilers

Sufficient power for operating the entire plant and the quarries is generated from waste heat. There are 3 1050-hp. Babcock & Wilcox waste-heat boilers equipped with Green fuel economizers and Diamond soot blowers. The exhaust fans are driven by 100-hp. variable speed General Electric motors. Boiler inlet temperatures are from 1150 to 1200 degrees F. Outlet temperatures are about 350 degrees.

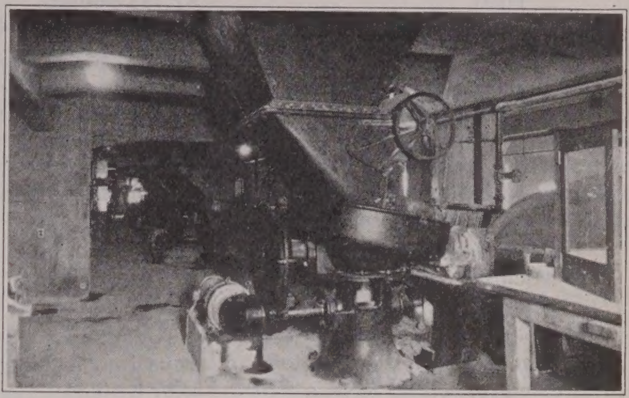


View of the firing end of the kiln, showing the sealing ring and the burning hood

Steam is generated at 225 pounds, 150 degree superheat. A 3000 k.w. and a 1500 k.w. turbine generator supply 3-phase, 60-cycle, 2200-volt current. Air for the entire plant is furnished by two 850 cubic foot Ingersoll-Rand air compressors.

Dust Precipitation

A Cottrell dust precipitation system, furnished by the Western Precipitation Company of Los Angeles, is installed in a separate building. This plant is used in addition to the usual dust collecting hoppers under the waste-heat boilers and equalizing flues. The dust is taken from the gases that usually go up the chimney. In addition to the dust it reclaims, the installation protects the surrounding country from the dust. This is especially important in a plant located as the Osborn plant is, adjacent to the city.



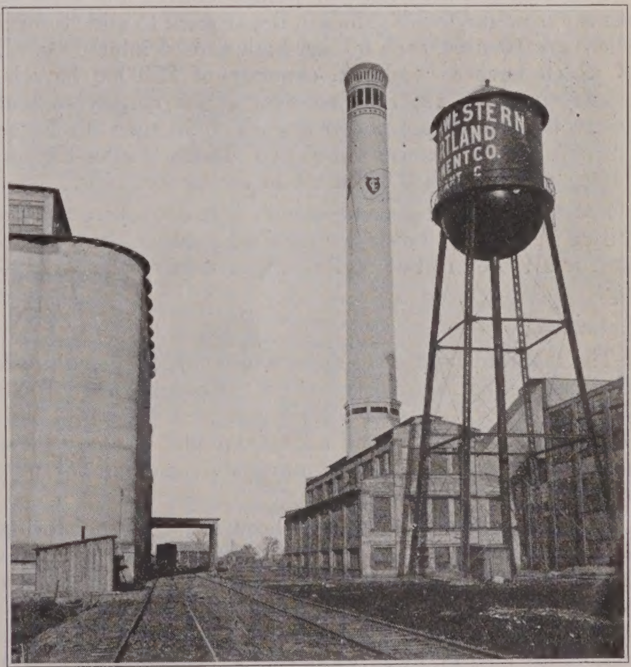
Revolving feeders for raw mills

The installation is composed of three separate treaters, any two of which are capable of handling the gases from the 3 kilns. Normally all three units are in operation. After the gases are drawn through the waste-heat boilers by the No. 7 Green economizer fans, they are delivered into a common horizontal flue through which the gases are conveyed to the precipitation building, through the Cottrell precipitator and out through the 190-foot concrete stack.

One of the daily "dust reports" will indicate the volume of material recovered by this installation. Tonnage tests were made as follows: 8 hours passing the gases through all three heaters with three kilns. At the end of the 8-hour run, No. 1 treater was stopped while Nos. 2 and 3 were left in operation. The dust collected in No. 1 treater was dumped on the floor, allowed to cool off and carefully weighed. Results are as follows:

First Test—No. 1 Treater

Dust collected in 8 hours..................14,096 pounds



The electric dust reclamation system is installed in a separate building. The concrete stack is 190 feet high

Second Test—No. 2 Treater	
Dust collected in 8 hours	13,855 pounds
Third Test—No. 3 Treater	
Dust collected in 8 hours	14,760 pounds
Total	42,711 pounds

(Not including stack, main flue and balloon flue collections.)

The precipitator installation consists of three 10-k.w. transformers which step up the current from 440 to 50,000 volts. These are passed to the plates for precipitation by motor-driven rectifiers. Each of the three treaters is equipped with four sections of reinforced concrete plates, and has a precipitation efficiency of 98 per cent.

Dust collected per kiln per hour	1,779 pounds
Dust collected per kiln, per day	42,711 pounds
Dust collected per hr. for 3 kilns	5,337 pounds
Dust collected per day for 3 kilns	128,133 pounds

Dust from the electric precipitator drops into a 9-inch spiral conveyor which feeds a 4-inch Fuller-Kinyon pump that conveys the reclaimed dust to the kiln feeders.

Clinker Storage

Three "torpedo conveyors" convey the clinker from the three Vulcan Iron Works coolers to clinker storage. These conveyors can be adjusted to discharge the clinker at three points, first, into a cross conveyor leading directly to the finish grinding mills; second, to an elevator serving the clinker storage tanks and third, to an elevator serving the general storage. Another torpedo conveyor is so placed that clinker from one of the elevators can be taken and distributed to the clinker mill feed bins. A third torpedo conveyor, and this one is about 180 feet long, is used for conveying the clinker from the silos to the clinker grinding department.

There are three clinker storage tanks or silos, having a total storage capacity of 90,000 barrels. Each silo is 50 feet in diameter and 67 feet high. Between two of the clinker storage silos, place is provided for a 90 days' supply of gypsum. The gypsum is fed directly to the torpedo conveyor carrying the clinker to the finish mills.

Stock and Pack House

Two 3-inch Fuller-Kinyon pumps convey the finished cement from the finish grinding department to silo storage. There are 10 silos, each 80 feet high and 14 interstices, all of which have a combined capacity of 250,000 barrels. Under the silos are four rows of screw conveyors that empty into two cross conveyors which in turn discharge through rotary screens into two 8-inch Fuller-Kinyon pumps which carry the cement to the packer bins.

Four 3-spout Bates packers with belt conveyors are installed in the pack house for railroad loading. In a separate room there are two additional packers for truck loading.

Laboratory

The laboratories are carefully and completely equipped. Physical testing laboratory equipment consists of a 1000-pound capacity Riehle tension machine, a 500-pound Boyd-Olsen tension machine, and a 29,000-pound capacity Pittsburgh Testing Laboratory compression machine for testing 2 by 4-inch cylinders.

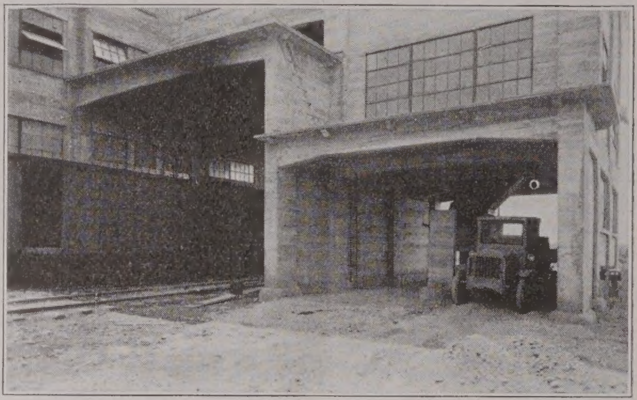
A soapstone moist closet has been installed for storing pats, briquettes and cylinders. In this cabinet temperatures are controlled to within two degrees and humidity is kept between 96 and 100 per cent. Briquettes and cylinders are stored in galvanized iron tanks through which there is a continuous flow of water thermostatically maintained at a temperature of 70 degrees.

Vicat apparatus is used for testing normal consistency and setting time and there is a W. S. Tyler rotap machine for testing fineness.

In the chemical laboratory the electrometric Wendt type titration apparatus is employed for determining the magnesia and iron content. This is installed in addition to the regular equipment common to all chemical cement mill laboratories. All tables are covered with Alberene stone tops. Laboratory equipment was furnished and installed by the E. H. Sheldon Co. of Muskegon, Mich.

In addition to the main laboratory, there are two branch laboratories in the mill. One is located in the raw grinding department and one in the fine grinding department. They make fineness and moisture tests and also test the coal for fineness.

For purposes of experimentation and research, a miniature cement plant has been installed in the laboratory. It consists of a crusher that will reduce 300 pounds of rock to ¼-inch size per hour, a ball mill capable of handling 150 pounds of material at a batch, another ball mill capable of grinding 25 pounds to the batch, a shaft kiln that can produce 100 pounds of clinker per batch. A rotary kiln 23 feet long, an exact miniature of the kilns used in the mill, is installed in the experimental laboratory.



Arrangements are made for shipping cement either by train or by truck

Service Testing Lab

There is still another laboratory at the Osborn plant of the Southwestern Portland Cement Company. This lab was installed entirely as a matter of service to cement users whether they buy Miami cement or not. In it tests of aggregates proposed for use in concrete construction are made and advice is given as to their suitability for use. In it, also, analyses of aggregates will be made for scientific proportioning, so that the user of cement may get the best possible results. Problems of construction, investigations of failures and technical advice are available through the facilities of this laboratory to every user of cement that cares to avail himself of them.

The service laboratory is completely equipped with all the necessary machines for this purpose. There has just been installed a 300,000 pound capacity Tinius-Olson compression machine, one of the largest type manufactured. There is a small Jaeger mixer and a transverse beam testing machine.

Personnel

Officials of the Southwestern Portland Cement Company are: At Los Angeles, Carl Leonardt, president; C. C. Merrill, first vice-president; C. A. Fellows, second vice-president; F. H. Powell, secretary and sales manager; W. C. Rieth, chief engineer. At El Paso, A. Courchesne, vice-president; J. C. McNary, treasurer. W. T. Groner is superintendent of the Osborn plant; R. R. Coghlan, chemical engineer; C. D. Clugston, sales manager.

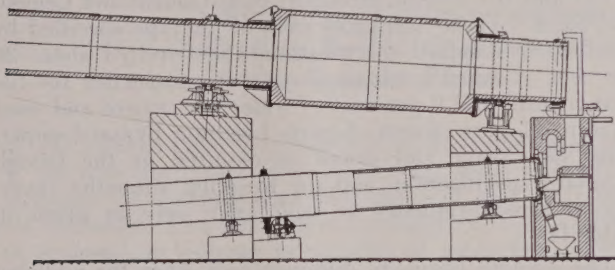
Enlarging the Zone of Calcination in Rotary Kilns

Special Kiln Design Increases Production

IN the August number of the "Revue des Materiaux De Construction Et De Travaux Publics," A. Merciot describes several improvements in rotary kilns, the most interesting of which is the enlargement of the zone of calcination in an effort to increase output economically.

This important improvement relative to the underlying principle of the construction of rotary kilns was patented during the war in Germany, but unfortunately it was not introduced into the cement industry during the war. It was on the occasion of the replacement in an old cement mill of some outworn rotary kilns that new kilns with the calcination zone enlarged according to principles advanced by Sellner and Ziegler were tried out. In the first days that these kilns were put in operation the use of the enlarged calcination zone increased the output at least 70 per cent, and provided a considerable economy in the amount of coal needed.

An illustration shows a kiln of 6½ ft. in diameter by 100 ft. in length with an enlarged calcination zone placed just forward of the zone of vitrification. This enlarged zone is about 11½ ft. in diameter by 33 ft. in length. It should not be confused with the zone of vitrification, for no vitrification should ever take place in the zone of calcination.



What explanation is there for this increase of output and economy of fuel which takes place when an enlarged calcination zone is employed?

Operation

The pulverized raw material of cement when prepared by the wet process always has more or less of a tendency to flow, and this tendency causes the raw material to travel the length of the kiln at varying speeds, with the result that different parts of the slurry have a tendency to separate from each other according to their various qualities. This results in a mixture that is often entirely unsuited to vitrification and which can be vitrified only in part. As a consequence, it is necessary to use a long zone of vitrification and to vary constantly the burning of the coal. This fact makes it impossible to get the maximum utility from the last few feet of the kiln.

In the new kilns designed by Sellner and Ziegler the drying slurry enters into the large drum where it is intimately mixed and regularly heated until it is delivered into a very short vitrification zone where it clinkerizes easily at the expense of considerably less coal than would be necessary otherwise. Raw material so uniformly prepared for vitrification would be expected to produce a better quality of clinker than that obtained by the ordinary process of burning, and this fact has been demonstrated to be true. Tests indicate that the strength of the cement produced from these special kilns is higher than that obtained under similar conditions from ordinary kilns.

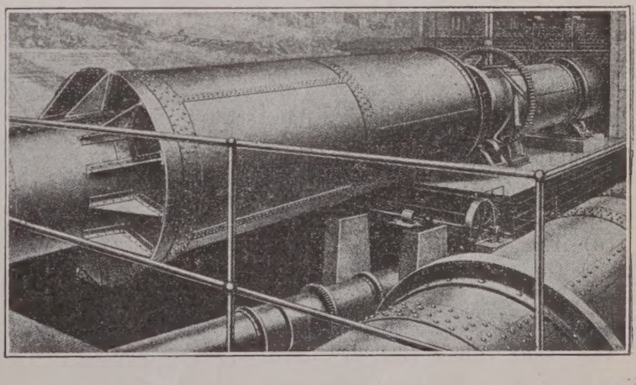
Advantages

On the strength of the results already obtained it is safe to say that the installation of an enlarged zone of calcination will increase the output of a kiln about 50 per cent when the dry process is used and about 30 to 40 per cent when the wet process is used. In addition to providing an increase in output, the enlarged zone also acts as an accumulator of heat, and since the raw materials are in the kiln a somewhat longer time than they would be if there were no enlarged zone, this design provides for a more complete utilization of the heat units in the fuel used.

It will be noted from the illustration that the zone of vitrification is very much shortened as a result of the installation of an enlarged calcination zone. Formerly the vitrification zone of this particular kiln occupied about 50 ft., a large part of which length was of necessity not wholly efficient. In the new design, the zone of vitrification occupies but a small space at the head of the kiln, with the result that the entire space which it does occupy is in efficient use.

Another illustration shows the further development of this idea—another modification of the rotary kilns of Sellner and Ziegler. These particular kilns are for wet process work and were designed particularly for the efficient handling of wet clay.

Near the zone of calcination there has been introduced a second zone which serves as a drying zone. This dries out the slurry more rapidly than formerly and does it in the shortest possible space. In the making of aluminous cement this feature is particularly valuable as it dries out the slurry with sufficient rapidity to avoid any hydration.



The presence of this drying zone eliminates considerable inconvenience which ordinarily accompanies the use of a plastic slurry, and reduces considerably the amount of fuel needed in rotary kilns that are not equipped with any special appliances for the rapid drying of the slurry.

By the combination of these two improvements in burning, it is often possible to increase the output of a kiln in the neighborhood of 40 per cent and at the same time reduce the fuel factor 10 to 20 per cent.

High Sulphur Content in Portland Cement

Some Experiments on the Effect of Sulphur on Portland Cement Described in Paper Presented Before the Institution of Civil Engineers—Results Tabulated from Experiments of Five Types of Specimens

By PROF. F. C. LEA
The University, Birmingham, England

Specifications for cement limit the allowable proportion of sulphur (as SO_3), and the question not infrequently arises as to whether cement should be condemned on account of the quantity of SO_3 present. The British Standard specification states that it shall not exceed 2.75 per cent. Manufacturers of cement add gypsum during the process of manufacture, the amount so added depending to a certain extent upon the season of the year and the setting time required.

The object of the experiments was to determine the effect, on the strength and soundness of cement, of varying the sulphur-content by the addition of gypsum; also its effect on steel embedded in the cement. The experiments have been carried out in the University of Birmingham, with cements specially made for the purpose. No attempt was made to produce a commercial cement that would satisfy the British Standard specification in all details.

Starting with a clinker containing about 2.5 per cent sulphur (as SO_3), other cements were made by the addition of proportions of gypsum, ranging from 1 to 10 per cent. Thus the percentage of sulphur was approximately as follows:

Cement sample No.	Gypsum added Per cent	SO_3 Per cent	Cement sample No.	Gypsum added Per cent	SO_3 Per cent
1	0	2.5	7	6	5.0
2	1	2.9	8	7	5.4
3	2	3.4	9	8	5.8
4	3	3.8	10	9	6.1
5	4	4.2	11	10	6.5
6	5	4.6			

With these special cements five types of specimens were made, and the following tests and observations were carried out:

(a) Le Chatelier tests for soundness;
(b) Tensile strength; neat cement;
(c) Tensile strength; cement and sand (1 to 3);
(d) Compression strength tests on 4 in. concrete cubes;
(e) The effect of sulphur on steel embedded in concrete cylinders.

The 4-in. cubes and the cylinders were suitable for observing the behavior of the cements as far as expansion and cracking with time were concerned. The details of these experiments and the results so far obtained are as follows:

(a) Le Chatelier Tests for Soundness.—Two specimens of each sample included in the following table were made, and the tests were carried out as specified by the British Standard specification for portland cement. As will be seen from this table, no appreciable expansion was obtained in any case; yet, as will be shown later, some of the concretes were undoubtedly unsound, expanding and cracking badly with time.

TABLE I.

Cement sample No. (all mixed with 26 per cent water)	Le Chatelier Expansion 1 Mm.	2 Mm.	Mean. Mm.
1	1.0	1.0	1.0
2	0.5	0.5	3.5
3	1.0	1.0	1.0
4	1.0	1.0	1.0
5	0.8	0.7	0.75
6	1.0	1.0	1.0
7	0.5	0.8	0.65
8	1.4	0.5	0.95
9	1.0	0.9	0.95
10	1.0	0.6	0.8

(b) and (c) Tensile Strength: Neat Cement and Cement and Sand.—These briquettes were of the type specified by the British Standard specification, and required about 26 per cent of water to obtain a suitable consistency for the neat cement, and 9 per cent of water for cement and sand mixture (1 part cement, 3 parts Leighton Buzzard sand). They were made and stored as required by the British Standard specification, and the breaking strengths (average of three briquettes at each age) were as given in Table II.

The strength begins to diminish only when the addition of gypsum has reached a total of 5-6 per cent, corresponding with 4½-5 per cent of SO_3. There appears to be a slight increase in strength up to about 4 per cent added gypsum (corresponding with just over 4 per cent SO_3).

TABLE II. TENSILE STRENGTH: NEAT CEMENT AND CEMENT AND SAND

Cement Sample No.	Average Strength 7 days Neat lb.	Cement and sand lb.	28 days Neat lb.	Cement and sand lb.
1	442	189	421	217
2	497	194	478	260
3	513	197	480	282
4	466	206	499	268
5	529	208	516	290
6	486	175	482	260
7	314	124	442	246
8	235	56	421	185
9	220	47	344	77

(d) Concrete Cubes for Compression Tests.—Owing to shortage of storage accommodation it was not possible to make blocks from all the samples of cement, and blocks were therefore made only of cements numbered 1 to 5, 7, 9 and 11. Eight cubes of concrete were cast with each of these cements, giving a total of 64 cubes. The concrete consisted of 1 part cement, 2 parts sand (from Cannock

(Continued on page 114)

Power Plant and Kiln Design and Operation

A Series of Articles on the Combined Processes of Power Plant and Kiln Operation, Considered as a Unit

By R. R. COGHLAN
Chemical Engineer
and
T. H. ARNOLD
Electrical Engineer, Southwestern Portland Cement Co., Osborn, Ohio

WITH this article we begin a series of practical discussions of the design and operation of power plants and kilns in cement plants. The combined processes in the kilns and boiler plant should be considered as a single unit in which there is no one feature that can be distinctly selected as affecting only the kilns or the boilers.

In these articles, the mechanical features will be discussed first, after which their interrelation and dependence on each other will be explained.

The following subjects will be covered:

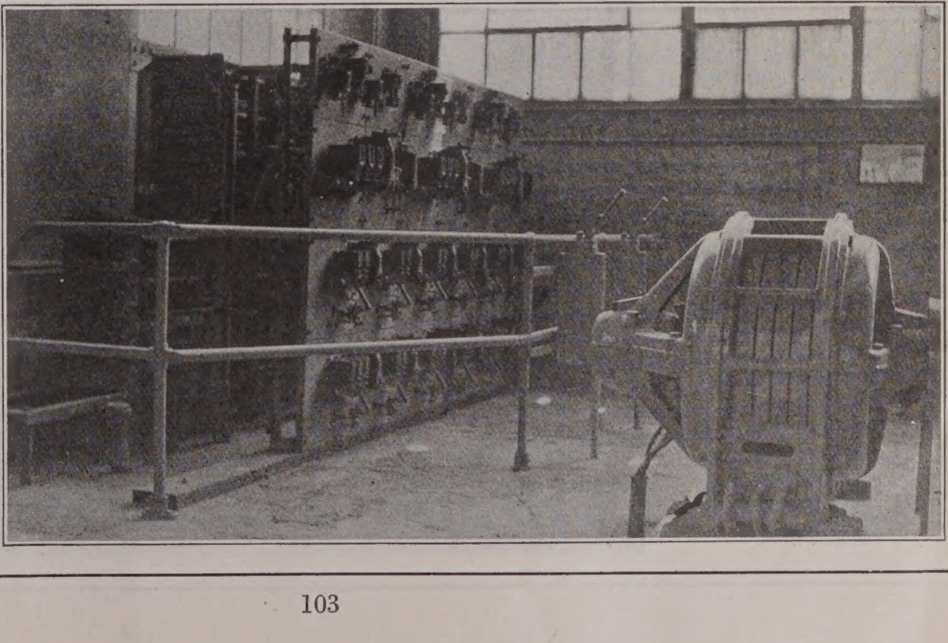
I. Waste Heat Boilers.
II. Flues and Other Gas Passages.
III. Instruments and Methods of Control.
IV. Kiln Combustion.
V. Kiln Design.
VI. Studies of the Results of Operation of These Units. —*The Editors.*

Chapter I.—Waste Heat Boilers

Bringing Out Various Features To Be Considered in Designing and Selecting Boiler Equipment and Showing How These Are Applicable to Cement Plants

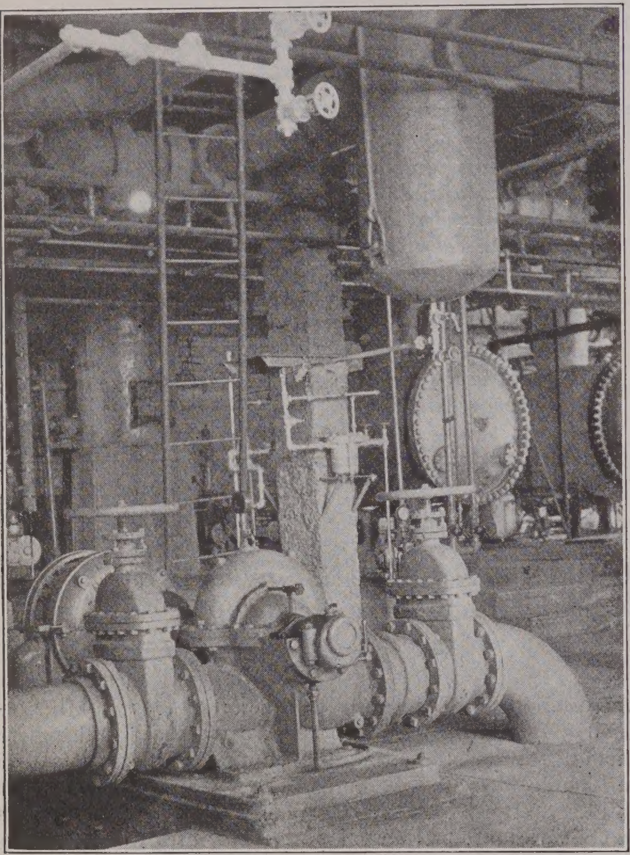
THE change from the shaft kiln to the rotary kiln for burning portland cement clinker was made with a full realization of the increased fuel required and the lower fuel efficiency. The advantages in changing to a continuous process, the increase in capacity of the units, and the reduction in the labor were of much more importance. While fuel was comparatively cheap, numerous endeavors were made to reclaim a portion of the additional heat very shortly after the introduction of the rotary kiln. As fuel increased in price efforts were increased and experimental results studied in the copper smelters, the steel mills and other furnace industries as well as in the cement industry. It was realized early in the investigations that the generation of steam for power purposes was an attractive solution.

Two factors contributed toward the failure of the earlier



Motor control for waste heat boiler fans installations. The principles of heat transfer from the gases to the heating surface were not well understood and the disposal of the dust which settled from the gases was a serious obstacle. The earlier boilers were adaptations of standard types of direct fired boilers with modified baffling and settings to reduce the draft loss. They were operated from stacks with low gas velocities at a capacity far below their rating.

The development of the modern theory of heat transfer with the application of high heat transfer rates has revolutionized the entire problem. Natural draft from stacks will not give sufficient draft for the high velocity of the gases necessary for the high heat transfer rate. Induced draft fans were thus added, and these were found to give additional output from the kilns owing to the more independent draft control.



Evaporators and steam piping. Also shows the circulating pump

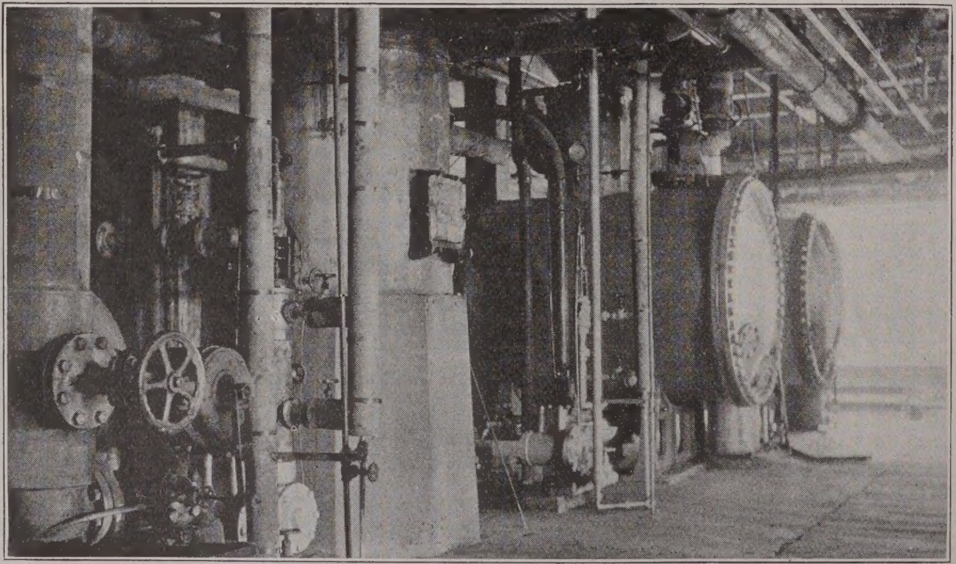
A better understanding of the design of the gas passages and means for the recovery and removal of the dust developed. In the recent designs of boilers and gas passages, the dust does not present serious difficulties.

The principles of increased velocity and turbulent flow may be applied to the fire tube boiler as well as the water tube boiler. The capacities required in the modern cement plant render the water tube boiler advisable, although for small furnaces in other industries very good results have been attained by specially designed fire tube boilers.

Waste Heat vs. Direct Fired Boilers

A very clear and concise discussion of the essential difference in the method of heat transfer in waste heat and direct fired boilers is given by McDermott (Association of Iron and Steel Elec. Engrs., 1921):

> "Comparing a stoker fired boiler with a combustion temperature of 2700° F. and a waste heat boiler at 1300° F., initial temperature, the absorption by radiation would be as,
>
> $$\frac{T^4 \text{ coal}}{T^4 \text{ waste heat}} :: \frac{(2700)^4}{(1300)^4} :: \frac{10.5}{1}$$
>
> The absorption by radiation in the case of the direct fired boiler will be 10.5 times as great as in the case of the waste heat boiler.
>
> Usually about 65 per cent of the total evaporation is by radiation and 35 per cent by convection. On the above basis with a 600 hp. boiler 7,025,000 B.t.u. are absorbed by convection and 13,050,000 B.t.u. by radiation. In the waste heat boiler only 1,300,000 B.t.u. can be absorbed by radiation leaving 18,700,000 B.t.u. to be absorbed by convection. Therefore the rate of heat transfer for a waste heat boiler per square foot of heating surface must be 2.75 times greater. This difference is further aggravated by the fact that in the modern waste heat boiler, the heating surface exposed to radiation is a very much less proportion of the total heating surface than in the direct fired boiler.
>
> Obviously with the increased weight and low temperature of the gases and with the absorption almost entirely by convection, the heat transfer rate must



Open-heaters and evaporators over storage tank for distilled water increase to a very high figure. This point of view is not always appreciated. It is not infrequently felt that since a low temperature waste heat boiler gives but 70 to 80 per cent of the builder's rating that the heat transfer rate is low, actually it is very high.

The high heat transfer rate is attained by an increase in gas velocity. The rate of heat transfer may be expressed in the form,

$$R = \frac{H}{T - t} = a + \frac{bw}{A}$$

Where R = heat transfer rate in B.t.u. per hr., per sq. ft. of heating surface per deg. F. difference in temp.

H = B.t.u. per hour transferred per sq. ft.

a and b are constants.

$\frac{W}{A}$ = mass velocity expressed in pounds of gas per hour per square foot of gas area in the gas passages.

In general "a" is greater for water tubes than for fire tubes,
is greater as the diameter of the tube decreases,
is greater as the space between the tubes decreases.

Similarly "b" is greater for water tubes than for fire tubes,
is greater as the diameter of the tube decreases,
is greater as the temperature difference between steam and water increases.

The following values are quoted from experimental data by the Babcock Wilcox Company and Messrs. Kressinger and Ray,

Outside Diam. of Tube in In.	For Fire Tubes	For Water Tubes
1	$R = 3.5 \text{ plus } .0013 \frac{W}{A}$	
2	$R = 2.0 \text{ plus } .0008 \frac{W}{A}$	
3	$R = 1.5 \text{ plus } .00065 \frac{W}{A}$	
4	$R = 1.1 \text{ plus } .0005 \frac{W}{A}$	$R = 2.0 \text{ plus } .0014 \frac{W}{A}$

The above values apply to 400 deg. F. mean temperature difference corresponding to waste heat boiler conditions.

It will be observed from the above equations that as the mass velocity is increased by reducing "A" the value of "R" increases. This is due to the fact that as the velocity increases the number of molecules of hot gases which penetrate the adhering film is increased and the insulating effect of this film is broken down. The turbulence due to the high velocity eliminates stratification of the gases and assists materially in the absorption of the heat. It is evident that the smaller the area of the gas passage the smaller the distance each molecule must travel to reach the heating surface, and the greater the velocity the thinner will be the adhering film of gas."

In the application of these principles to the design of a boiler it is evident that a rearrangement of the heating surface in the gas passages will be necessary. Two general methods have been developed to place the required amount of heating surface in gas passages of suitable area to give the high gas velocity. The tubes may be arranged to produce narrower and longer gas passages. Thus a given amount of heating surface which would be arranged in a direct fired boiler as twenty-four tubes wide and eighteen high would be rearranged for a waste heat boiler as eighteen tubes wide and twenty-four high. The same results may be accomplished by decreasing the size and increasing the number of passes.

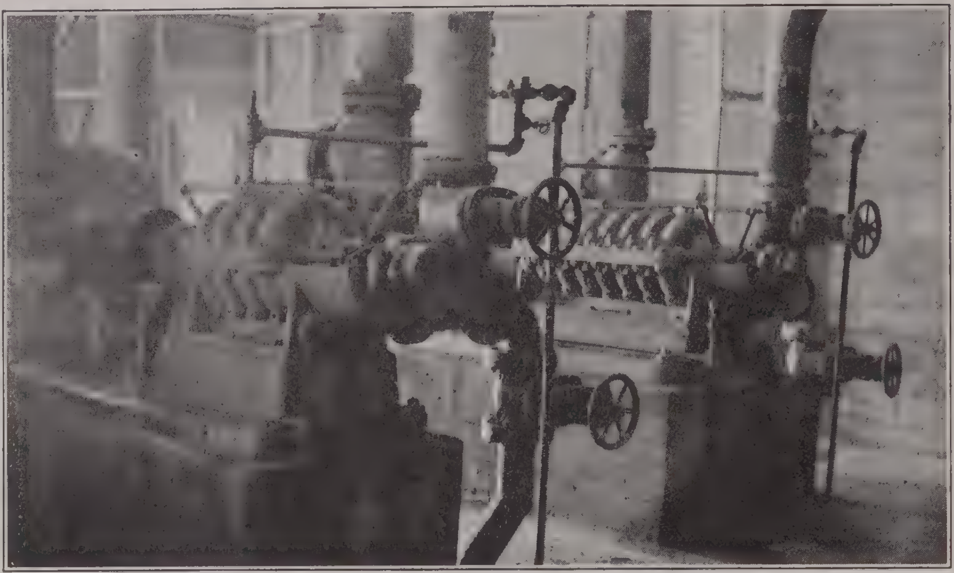
The draft drop through the boiler will vary with the area and length of the passes and with the square of the velocity. The power at the fan for producing the velocity will vary as the square of the velocity. An economic balance will thus be reached where the additional heat transfer obtained will be offset by the additional power required for producing the draft.

With drafts necessary for high heat transfer rates, the natural draft stack is impractical. The draft drop through modern boilers will vary from 1.5 to 4 in., the economizers will require from 0.5 to 2 in. The addition of the loss in the flues and the draft required at the kiln outlet will bring the total from 3 to 7 in. The gas temperature for economical operation at the economizer outlet should not exceed 350 to 400 deg. F. Under these conditions the

Variable-speed motors driving waste-heat boiler fans induced draft fan offers the only practical means for producing the necessary draft.

Economizers

The economizer plays a very important part in the success of a waste heat boiler plant. Few modern plants are designed for boiler pressures less than 200 lbs. With this pressure the gases will leave the boilers at 500 deg. F. or higher. The high gas weights and the high specific heat of the gases from cement kilns, especially in the wet process, would result in excessive heat loss in the gases if discharged at this temperature. The moisture content of the gases is unusually high, thus a discharge temperature of 300 deg. or more must be maintained to prevent condensation in the flues, dust precipitators, or stack. The ratio of gas weight to water weight will allow the utilization of 100 to 150 deg. F. reduction of gas temperature in the economizer to heat the feed water to a point slightly below the saturated steam temperature. Further heat recovery will cause trouble from steam generation in the economizers.



Boiler feed pumps —one motor-driven, the other steam-driven

Deaereator for boiler feed water

Individual economizers built as a part of the boiler unit without by-passes constitute the most satisfactory arrangement. The economizer will require less shutdowns than the boilers and the large amount of gas to be handled in each unit will result in units of economic size. The induced draft fans are usually connected directly to the economizer outlet.

The performance of some individual economizers are given below:

Temp. of Gas Deg. F.			Temp. of Water Deg. F.		
Entering	Leaving	Drop	Entering	Leaving	Rise
509	401	108	163	295	132
495	307	188	178	307.5	129.5
504	397	107	178	308	130.0
506	392	114	163	293	130.5
463	360	103	182	311	129.0

The composition of the gases will have a marked effect upon the performance of the economizers. The mean specific heat of the gases will vary widely with the burning conditions and the percentage of water vapor in the gases. The economizers should be designed for the heat transfer rate with the high gas velocities in a similar manner to the boiler.

Superheaters

Superheaters are installed in a very similar manner to those in direct fired boilers but the proportions will vary with the gas temperature, weight and specific heat. The high heat transfer rate may be used on both the gas and the steam sides of the tubes.

It would be presumed that the high velocity of the gases in these boilers would prevent any large amount of dust settling on the heating surface. Such is not the case, how-ever, the dust settles rapidly upon the tubes, and if not removed at frequent intervals will interfere seriously with the efficiency of heat transfer. Many plants have been unsuccessful in the removal of dust accumulations with soot blowers. This may be partially due to incorrect location of the blowing elements or to too short an application of the steam in the operation of the blowers. A rather slow travel of the blowing element is necessary as an appreciable time is required for the element to dislodge the dust in its area of operation. Incorrect location or shifting of the element may result in cutting of the tubes or baffles.

Much difficulty has been encountered from a firm deposit of material in the first pass which the soot blowers will not dislodge. This material has a peculiar appearance resembling the tip of a bird's wing pointing toward the gas stream. These deposits form on the brickwork or the tubes and grow to quite large size. Once formed this material clogs the gas passages and the only remedy is to shut down and clean it out. An investigation of samples from several plants gave similar chemical analysis. The composition was largely calcium sulphate in the anhydrous form with a high alkali content. It is probably deposited in a pasty form and adheres tightly to the surfaces. This formation follows the use of coal or materials with a high sulfur content and is probably due to reaction of the SO_2 in the gases with the lime in the suspended dust in the gases. Low sulfur materials will avoid the formation.

Dust Collection

Hoppers of ample size to settle out the dust should be placed below each pass of the boiler with provision for the economic removal of the accumulated dust. The tendency is to underestimate the amount of dust carried by the gases, and the fact that a small amount of dust is collected in small hoppers only indicates that eddy currents prevent the dust from settling out and whirl it back into the main stream of gases. The design of these hoppers will be discussed in a later article.

Brick settings without heat insulation have been used to a large extent. The steel casings with heat insulation behind the fire brick, while somewhat more expensive, will rapidly repay the additional cost in the reduced radiation and air infiltration losses.

Plants with plain brick settings also find that they must burn extra coal either in the kilns or in auxiliary boilers to generate their full power requirements. With waste heat boilers air infiltration and radiation are of great importance and must be kept at a minimum. The difficulties in maintaining a brick setting free from air leaks in ordinary boiler practice are well known. If the internal draft is raised to the values current in waste heat work of three to seven inches of water, these difficulties are multiplied. The bad effects of air infiltration will be discussed in detail in a later article.

Boiler baffles must withstand greater pressures in waste heat boilers. The high gas pressures and the dust in suspension will cause rapid erosion in case any openings develop. The baffles must be very substantially constructed and carefully inspected at intervals in operation to avoid leaks.

Conditions sometimes exist where explosive mixtures exist in the gases. Explosions may be quite violent and unless adequate provision is made to relieve the pressure the effect upon the boiler setting may be disastrous. A sufficient number of explosion doors should be distributed throughout the settings to relieve any excessive pressure. These doors may be used to gain access to the various passes of the boilers. These doors are designed to close by gravity and are self-sealing to prevent air leakage.

Chapter II of this series, "Flues and Other Gas Passages," will appear in the November number.

Cement in Japan

(Special Correspondence)

Tokyo, September 8.—Complaints regarding the low quality of Japanese portland cement are coming from the East Indies. Last year Japan supplied 88 per cent of the cement imports of the Dutch colonies there and so far this year has been holding her own with an 84 per cent average. German and Dutch brands have been driven from the market, to all intents and purposes.

Dutch newspapers in Java are conducting a vigorous propaganda campaign against the Japanese product, much of which, they say, is virtually unserviceable. The Dutch East Indian Government Supply Bureau recently purchased a large quantity of low-quality cheap Japanese cement and had to throw it away, losing 60,000 guilders by the transaction.

A technical laboratory connected with the Dutch colonial administration later tested all the brands on the market and gave only the Asano and Onoda outputs clean bills of health.

This condition has awakened Japanese cement manufacturers and they are agitating for some kind of supervision of exports. It is probable that the matter will go before the Japan Cement Association at its next meeting.

Domestic demand is slackening but exports are going out at a lively rate. The mills here are sending their surplus stocks to Manila, Iloilo, Singapore, Hawaii and South America. Most of the consignments are loaded at Yokohama and Moji.

Cement companies are still restricting production for the home market by 35 per cent but the market is subject to long fluctuations, ranging between 4 and 5.30 yen a barrel. Mr. Soichiro Asano, president of the company which bears his name, has proposed that a further cut in production, of from 10 to 15 per cent, be placed in effect. The association is to discuss the matter.

During July the various companies sold 515,000 barrels, Asano leading with 250,000. Chichibu and Iwaki followed with 55,000 barrels each and Toyokuni was third with 34,000.

Mr. Sozaburo Miyakawa of the Asano interests has come forward with a proposition that Japan abolish her protective tariffs on cement in view of the fact that practically none is imported and the lowering may induce other countries to do the same.

Japan now supplies about half of the annual needs of the South Sea regions, which include the Philippines, the East Indies and Malaya. The total consumption there is about 3,000,000 barrels a year.

Mr. Miyakawa hopes that the United States can be persuaded to lift the tariff of 1.30 yen per barrel in the Philippines. This is the highest tariff of its kind in the world and was put into effect to protect the Cebu Cement Company.

Correcting an Error

We wish to correct a statement made through our error in the advertisement of the Burrell Engineering and Construction Company, appearing in our September issue. The statement that the new plant of the Louisiana Portland Cement Company at New Orleans was "designed and built by the Burrell Engineering and Construction Company" should have read simply "built by the Burrell Engineering and Construction Company." This correction was made by the Burrell Engineering and Construction Company on the proof which they received, but unfortunately the corrected proof reached us too late to be incorporated in the advertisement.

MEN and MILLS

Notes from the Field

Dexter Ratifies New $35,000,000 Merger

$13,000,000 Bond Issue Floated to Finance the New Pennsylvania-Dixie Corporation as the Consolidation Is Now Known

A special meeting of the stockholders of the Dexter Portland Cement Company was recently held, at which it was voted that the company sell all its assets and properties to the recently incorporated Pennsylvania-Dixie Cement Corporation, that the Dexter company be dissolved, and that the company be made a part of the above merger. Thus the Dexter company has finally ratified its union with the other cement companies now forming the Pennsylvania-Dixie corporation as outlined in our last two issues. The other companies involved include the Pennsylvania Cement Company, the Cayuga Cement Company, the Clinchfield Cement Company, and the Dixie Cement Company. The result is a $35,000,000 cement company that has a present annual capacity of 10,000,000 barrels.

A $13,000,000 bond issue has been floated to finance this great merger. A syndicate of investment firms offered that amount in first mortgage sinking fund 6 per cent gold bonds, Series A, to mature in 1941, at a price of 99½ plus interest, to yield 6.05 per cent. The consolidated balance sheet as of July 31, of the properties and business to be acquired by the new corporation, including financing incident to the merger, shows current assets of over 4.9 times current liabilities, and net current assets of $6,024,865, or over 60 cents per barrel of capacity. This bond issue was quickly oversubscribed, which should help revive the industry in the Lehigh district.

Keystone to Spend Two Millions

The Keystone Portland Cement Company has purchased 373 acres of land at Bath, Pa., adjoining the property of the Bath Portland Cement Company, and expects to spend $2,000,000 for a new plant at that site. The proposed unit will be designed for the wet process and will have a daily capacity of 3500 barrels and an annual output of 1,200,000 barrels. The new plant, for which plans are now being perfected, is expected to be a model plant, containing the very latest labor saving devices, and is to afford the ultimate in production efficiency.

Pennsylvania Company Erects New Office Building

The Bath plant of the Pennsylvania Cement Company, to be a part of the new Pennsylvania-Dixie merger, mentioned elsewhere in these columns, is erecting a modern fireproof 3-story office building, 60 by 40 feet, together with a concrete garage, 60 by 20 feet. No wood is used in either structure. Even the office furnishings are to be of a fireproof nature. This is quite in line with other developments of this noted concern. The concern is purchasing land and improving present plants to provide for future requirements. Morris Fortuin is superintendent at Bath.

Important West Coast Merger Is Rumored

Reports emanating from reliable sources point to the early merger of two west coast cement manufacturers, the Oregon Portland Cement Company, Oswego, Oregon, and the Sun Portland Cement Company, at Lime, Oregon. It is said that the new corporation will be known as the Oregon Portland Cement Company, and incorporation will be effected under the laws of the state of Nevada. The plan is said to have been approved by the board of directors of each company and the plan is being put up to the shareholders for approval. The list of stockholders in the two companies appears almost identical. It is proposed that the new company shall have an authorized issue of $1,500,000 in 7 per cent cumulative sinking fund first preferred voting stock, to be exchanged on an even basis for outstanding shares in the two old companies. In addition, there is to be an authorized capital issue of $1,430,300 in 7 per cent convertible preferred stock, and 71,515 shares of Class A no par common voting stock and 57,212 shares of Class B no par common stock without voting power. The new corporation will have $500,000 for working capital and for increasing the Sun plant's capacity to 700,000 barrels yearly. R. P. Butchart is president of both companies.

Dykerhoff Tells of German Fuel Economies

"Cement manufacturers in my country," said Dr. Walter Dykerhoff, prominent German producer of cement, during the course of a visit to the office of CONCRETE last month, "use more labor in their plants than do the American producers of portland cement, but they have perfected certain methods that enable them to burn clinker with but a fraction of the coal that is used for the same purpose in America."

Dr. Dykerhoff expressed great interest in the methods of American investigators who are striving to solve the chemical problems of the cement industry and is following current American investigations very closely. American production methods, too, have been occupying his attention. In fact, he has spent several months visiting plants in this country and has become actively interested in the methods that he observed.

About 20 per cent of the output of the mills with which Dr. Dykerhoff is associated is what is commonly known as "Super Cement." It is simply an ordinary portland cement of extremely high quality, and which as a result gives concrete of very high early strength. Dr. Dykerhoff states that his firm had not been particularly anxious to engage in the manufacture of this special cement in addition to their regular brand, but that the development of construction methods made it necessary for them to do so in order to hold their trade. He gave it as his opinion that if concrete construction continues to progress in this country during the next few years as it has in the past, a recognized standard for cements of higher quality than ordinary portland cement will be necessary.

Changes in Cement Tariff Are Announced

The Interstate Commerce Commission has announced that it has suspended, from August 15 until December 13, the operation of railroad tariff schedules which propose to cancel provisions applicable to cement in southern classification territory, which at present provide that cement, natural or portland, will be subject to a carload minimum weight of 50,000 pounds, except that when, for carrier's convenience, a car of less capacity is furnished, the minimum weight will be the capacity of the car, but not less than 40,000 pounds, and apply, in lieu thereof, a straight carload minimum of 50,000 pounds.

300-Foot Kiln in New Trinity Plant

Trinity Portland Starts Construction on Cement Works to Produce 7,000 Barrels Daily with 4 Kilns

The construction of the new Houston, Texas, plant of the Trinity Portland Cement Co., located on Buffalo Bayou, has been started. Plans call for a plant that will cost approximately $2,000,000 and have a daily production of approximately 7,000 barrels of standard portland cement. The site comprises 17 acres of land located on the ship channel in order that shells and other materials may be received on barges. An office building, laboratories, plant buildings, storage silos, packing house, machine shop and power house, together with a 250-foot stack, wharfage, railway tracks, and a half mile of paving are to be constructed. Four kilns will be installed, each 11 ft. 3 in. in diameter and 300 ft. long.

One structure will house the clinker storage, 100 ft. by 125 ft.; grinding rooms, 100 ft. by 165 ft., and clay and shell storage, 100 ft. by 350 ft. A four-yard bucket on a traveling crane will serve this unit. Its lifting capacity will be approximately 7 tons.

The packing house will be 50 ft. by 70 ft. and will be served by eight silos, each 34 ft. in diameter and 100 ft. high. The office and laboratory will be housed in a two-story reinforced concrete building 50 by 55 ft. The machine shop will be contained in a steel and concrete building measuring 40 ft. by 227½ ft., one story high, and built of steel and concrete.

Four railroad tracks, each about a quarter mile long, will be laid on the property, as well as a half mile of concrete streets. About 600 ft. of wharfage will be constructed to take care of the barge traffic.

In the manufacture of the cement at this plant, the raw materials will be delivered by barge and stored until needed. The first step will be the grinding of the materials and the preparations of the slurry, which will then be conveyed to the kilns. The resulting clinker will then be conveyed to the clinker storage pile, and from there through the finish grinding mill and the packing house. The capacity of the silos will be approximately 176,000 barrels, which should be sufficient for the 7,000 barrels of cement that can be turned out each day.

The new plant is expected to be in production within a year, at which time a staff of at least 100 men will have to be employed. The construction is being carried on for the owner by the Southwestern Engineering Company, Springfield, Mo., with W. B. Stegman and Fred Burkett representing that company on the job. O. B. Bartholomew, chief engineer of the Trinity Portland Cement Co., represents the owners.

Annual Safety Meeting in Detroit This Month

Several cement company officials are scheduled to tell how their plants achieved worth-while safety records during the past year during the sessions of the cement and quarry sections of the National Safety Congress, to be held in Detroit, October 25 to 29. This live subject is one that engrosses every mill officer, for current safety activities have taken such a hold on the industry that lost-time accidents and fatalities are giving way before the onslaughts of the experts who are giving their constant attention to the matter. Timely, then, are the papers that are to be read before the sessions.

For instance:—G. S. Brown, president of the Alpha Portland Cement Company, will tell how executives regard the efforts to reduce accidents in the industry. Eugene T. Green, manager of the insurance and personnel department of the Riverside Portland Cement Company, Los Angeles, will discuss the relationship between the physical examination and accident prevention. Edward H. Parry, of the Glens Falls Portland Cement Company, Glens Falls, N. Y., will tells of a year's experience with a borrowed plan.

Round table discussions of interest to the quarry men will take up such subjects as "How to Protect Workmen with Regard to Storage Bins," "Protecting the Individual Versus Guarding Machinery in a Stone Crushing Plant," and the "Advantages of Inspection Trips to All Operators on Each Stone Outcropping." The safe handling of explosives in the quarry will be given quite a bit of attention.

The old dome kilns of the Pennsylvania mill of the American Cement Co., now the Giant Portland Cement Co., at Egypt, Pa.

Keystone Elects New Officers and Directors

The Keystone Portland Cement Company, of Bath, Pa., recently incorporated under the laws of that state, has completed the purchase of some 300 acres of land to the west of Bath and is now drawing plans for the mill and associated structures. A survey by Richard K. Meade & Co., which was made before the options were taken up, and by Prof. G. L. Miller, head of the Geological Department of Lehigh University, reported an almost inexhaustible supply of high grade cement rock available in the holdings. The new plant is to be of steel and concrete construction and will be designed for the wet process.

The officials of the new company are John M. Buckland, president, who is also president of the National Slag Company, Allentown; Fred B. Franks, vice-president and general manager, former mill manager of the Bath Portland Cement Co.; R. P. Johnson, secretary; and Judge Edward J. Fox, of Easton, the treasurer. The directors are John M. Buckland, Rufus W. G. Wint, H. H. Farr, Herbert F. Dillard, Fred B. Franks, Judge Edward J. Fox and Charles H. Groman.

The Keystone plant will cost about two million dollars and it is expected that work will start as soon as the contracts can be awarded. Mr. Franks will be in charge of construction operations.

Lawrence Portland Cement Co. to Build Maine Plant

The Lawrence Portland Cement Company, Northampton, Pa., is completing the purchase of a large tract of land, including limestone deposits, at Thomaston, Maine, and will use this property for the construction of a new cement mill. Plans are to be drawn for the initial unit, which will consist of a group of buildings with power house, machine shop, and auxiliary structures. The cost is expected to be in excess of $1,750,000. Work is to begin late this year or early in 1927. Limestone properties located at the new site will be developed, and equipment will be installed for that purpose. The main mill of the company, located at Siegfried, Pa., will be continued in operation as heretofore. Frank H. Smith is president, and E. R. Ackerman vice-president of the company.

Atlas Company Obtains New Options in Monroe County

The Atlas Portland Cement Company has obtained several options to purchase farm land near Saylorsburg, Monroe County, Pennsylvania, in order to obtain further deposits of white clay. Their eventual purchase of these properties will add to their present extensive holdings in that district.

Pennsylvania Safety Men Visit Atlas Plant

Prominent officials of the Department of Labor and Industry, Harrisburg, Pa., accompanied by the local district inspector, Charles P. Lynch, of Allentown, spent one day recently making a thorough inspection of the Atlas Portland Cement Company plant at *Northampton*, Pennsylvania. They arrived at the plant early in the morning and in company with the executive officers of the company visited every department of the plant. At the conclusion of this inspection trip the officers were informed that the plant not only complied with all state requirements at every point, but that these requirements were actually exceeded in many instances.

The inspection trip was followed by a series of meetings that took up the rest of the day, at which short instructive talks were given by the labor and industry representatives, meetings were held with the plant foremen, and then a large mass meeting was held, at which all employees were present. At this affair addresses were made on the subjects of "Co-operation with Safety Engineers," "Goggles and Their Use," and "Explosives." W. W. Winsch, plant manager, accompanied the inspection party and organized the various meetings.

K. H. Talbot Joins Cowham Engineering Co.

Announcement has recently been made of the appointment of K. H. Talbot as manager of cement sales of the Cowham Engineering Company.

The Cowham Engineering Company are designers, builders and operators of portland cement plants. They act as managers and operators for three plants of the Consolidated Cement Corporation located at Cement City, Mich., Fredonia, Kan., and Mildred, Kan.

The company is now constructing a 1,500,000-barrel plant at Tampa for the Florida Portland Cement Company, and has recently announced the construction of a plant at Rockland, Maine, to begin in the near future.

The combined output of the present operating plants is approximately 4,000,000 barrels. With the completion of the plants now being built and contemplated this will be increased to 6,500,000 barrels, making the Cowham chain one of the largest in the country.

Mr. Talbot was formerly with the Centrifix Corporation of Cleveland. Prior to this he was connected with the Koehring Company at Milwaukee and the Universal Portland Cement Company at Pittsburgh and Chicago.

Work of Association Laboratory Told

The end of a decade of cooperative research between Lewis Institute, Chicago, and the Portland Cement Association was celebrated at a luncheon held at the Midday Club, in Chicago, recently. George Noble Carman, a director of the institute, spoke of the salutary effect upon industry when such research is undertaken, while Dr. Duff A. Abrams told of the work that had been accomplished during the ten-year period prior to moving the laboratory to the association building. He said that more had been found out about concrete in the past ten years than during all the centuries that had gone before.

McCourtie's Famous Horse Retired from Track

"Mr. McElwyn," the famous four-year-old stallion owned by W. H. L. McCourtie, president of the Trinity Portland Cement Company, has been retired to stud. This takes from the track one of the outstanding stallions of recent years. It is Mr. McCourtie's hope that other winners will carry the qualities of this trotter to the races of coming seasons.

The horse has had a very brilliant career, according to racing fans. At two he won the Sunny Day stake at Readville, Mass.; the Nutmeg at Hartford, Conn.; the Recreation Park, at Kalamazoo, Mich.; and the junior Kentucky futurity at Lexington. At three he won the Champion Stallion, the Matron stakes, the Review, the Horseman, and the Kentucky futurities, as well as other stakes. In the last named event he set a world's record for two heats by a trotting stallion, of any age, in 2:02 and 2:02¾. His last demonstration, before beginning his career as a sire of race horses, took place at Phoenix, Arizona, last spring, when he trotted his mile in 1:59¼, which broke all previous records for four-year-olds.

Giant Portland Earnings Good

W. L. Haehnlen, vice-president of the Giant Portland Cement Company, Philadelphia, and reported to be the largest individual stockholder of the company, pointed out in a recent interview that earnings of that company were satisfactory at this time, but that they will not be quite up to the expectations of the management because of the recent price reductions. He stated positively that no deal is under way for a sale or consolidation, and that no such move is being contemplated.

$2,000,000 Bond Issue for Gypsum Merger

The merger of the Universal Gypsum Company and the Palmer Lime and Cement Company into an organization that will bear the name of Universal Gypsum & Lime Company is being financed by a two million dollar bond issue. The securities were offered on the market on September 22. The new $10,000,000 corporation is now said to be the second largest producer in the industry.

According to True, Webber & Co., the Chicago investment firm interested in the financing of the merger, the bond issue will constitute the company's only funded debt, and will be secured by a direct first (closed) mortgage on all of the real estate, plants, machinery, equipment, and other fixed assets of the corporation except certain minor equipment located at the company plant at York, Pa. These first mortgage sinking fund gold bonds will bear an interest rate of 6 per cent, and are now priced at 96 and interest, to yield about 6.35 per cent.

The company manufactures and distributes a complete and diversified line of gypsum and lime products, used in agriculture, construction, the manufacture of portland cement, and for chemical and industrial uses. The properties of the company are located at Fort Dodge, Iowa; Akron, Brooklyn, and Batavia, New York; Rotan, Texas; York, Pennsylvania; and Oranda, Virginia. At these points the company operates three gypsum mines, four limestone quarries, four gypsum plaster mills, one retarder plant, a gypsum tile works, four gypsum wall board works, and two plants for manufacture of a full line of lime and limestone products. At Brooklyn, New York, the company is acquiring a tract of land that is favorably situated at tidewater on Maspeth Creek and on the main line of the Long Island Railroad, upon which site the company plans to build a modern plant. Due to the location of these plants the company is now able to easily serve all the territory east of the Rockies.

W. E. Shearer is president of the new organization.

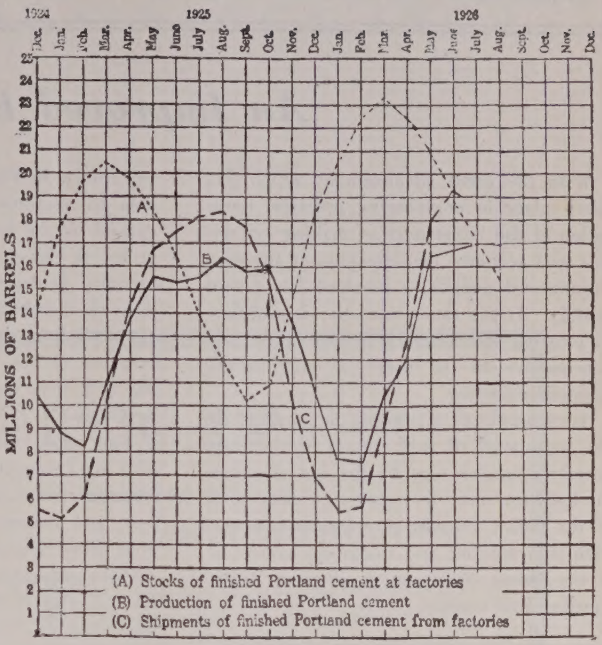
Alfonso De Navarro Dies

Alfonso De Navarro, vice-president of the Atlas Portland Cement Company, lawyer and prominent clubman, died suddenly at the shooting lodge of George F. Baker, Jr., at Brechin, Scotland, on Sunday, August 15.

Mr. Navarro was born in New York in 1863. He was a director of the Equitable Life Assurance Company, a trustee of St. Patrick's Cathedral, and held membership in eight of the leading clubs in New York.

Cement Statistics for August

AUGUST production and shipments of portland cement were the greatest for that month in any year, according to the Bureau of Mines, Department of Commerce. Production of portland cement was exceeded only by that of July, 1926, while shipments were exceeded only in the two preceding months. Portland cement stocks continued to decline but at the end of August were nearly 31 per cent higher than on August 31, 1925. These statistics, prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines, are compiled from reports for August, 1926, received direct from all manufacturing plants except three, for which estimates were necessary on account of lack of returns.



Estimated Clinker (Unground Cement) at the Mills at End of Each Month, 1925 and 1926, in Barrels

Month—	1925	1926
January	7,017,000	9,074,000
February	9,497,000	10,931,000
March	9,962,000	12,284,000
April	9,731,000	12,934,000
May	9,053,000	11,649,000
June	7,937,000	10,086,000
July	6,961,000	*8,515,000
August	5,640,000	7,270,000
September	4,561,000	
October	4,086,000	
November	5,013,000	
December	6,469,000	

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*Revised.

Production, Shipments and Stocks of Finished Portland Cement, by Months

Month—	Production 1925	Production 1926	Shipments 1925	Shipments 1926	Stocks at end of month 1925	Stocks at end of month 1926
January	8,856,000	7,887,000	5,162,000	5,672,000	17,656,000	20,582,000
February	8,255,000	7,731,000	6,015,000	5,820,000	19,689,000	22,384,000
March	11,034,000	10,355,000	10,279,000	9,539,000	20,469,000	23,200,000
First quarter	28,145,000	25,973,000	21,456,000	21,031,000		
April	13,807,000	12,401,000	14,394,000	12,961,000	19,877,000	22,640,000
May	15,503,000	16,472,000	16,735,000	17,951,000	18,440,000	21,173,000
June	15,387,000	16,827,000	17,501,000	19,113,000	16,409,000	18,900,000
Second quarter	44,697,000	45,700,000	48,630,000	50,025,000		
July	15,641,000	*17,096,000	18,131,000	*18,786,000	13,896,000	*17,210,000
August	16,419,000	16,936,000	18,383,000	18,536,000	11,952,000	15,610,000
September	15,939,000		17,711,000		10,247,000	
Third quarter	47,999,000		54,225,000			
October	15,992,000		15,309,000		10,979,000	
November	13,656,000		10,187,000		14,534,000	
December	10,713,000		6,917,000		18,365,000	
Fourth quarter	40,361,000					
	161,202,000					

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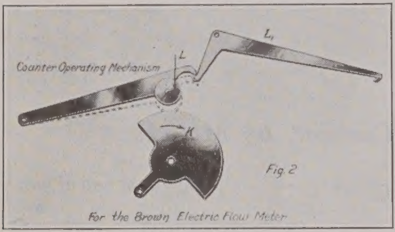
*Revised.

Mill Equipment

An Improved Electric Flow Meter

With the great advancement which has taken place in engineering practice, realization of the importance of making systematic and accurate meaurements of the conditions and quantities involved has grown rapidly. At the same time, the desirability of locating the meters at points of greatest convenience to the users is most keenly appreciated today.

An example of this trend is supplied by the popularity of flow meters of the electrically operated type by the use of which an indicator may be located in clear view of the boiler fireman as a guide in firing, with the recorder and integrator placed at a convenient point among a group of recording instruments.



For the Brown Electric Flow Meter

Among the characteristics of the new line of Brown electric flow meters are the following features:

The readings of the instrument are fundamentally independent of the value of the voltage impressed upon the electrical system. The instrument reads correctly, while operating on varying line voltages, without the use of either voltage regulators or compensators.

A pen operated by the action of the integrator mechanism makes a record at the outer edge of the chart each time the integrator mechanism increases the counter reading by one unit. Each tenth mark is distinguishable from intermediate marks in order to facilitate counting.

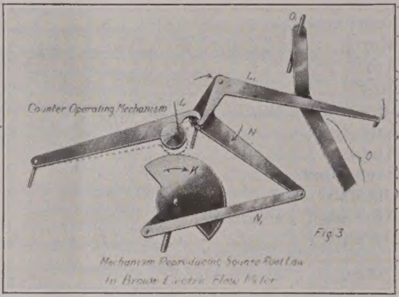
As shown in Fig. 1, manometer A operates in response to differential pressure caused by the flow of the fluid through an orifice B. When the rate of flow increases, mercury is depressed in chamber A^1 and rises in chamber A^2, the difference in mercury level in the two chambers being a measure of the rate of fluid flow through the orifice in accordance with well-known principles.

The outer ends of the divided winding EE^1 are connected directly across the service mains of an alternating current supply line and connections are run from these ends directly to the outer ends of a similar divided inductance coil FF^1 which operates an indicator H and also to divided inductance coil GG^1 operating a recording instrument 1. Armatures are hung on counterbalanced arms J and K in the two instruments. The points of connection between the two parts of divided coils EE^1, FF^1, and GG^1 are all connected together by a neutral wire P and when thus connected the coils form the self-adjusting inductance bridge which is the oustanding basic feature of this flow meter.

Attached to the gear train which drives the recorder chart is a sector of a disc K (Fig. 2) which rotates at a constant rate. A roller L is normally held up by latch L^1, out of contact with the sector.

The square root relation existing between rate of flow and pressure difference (the latter being translated into recorder pen travel) is reproduced in the relation between angular travel of disc L and pen deflection by means of the oscillating latch carrier N being driven by the rotating sector K, through a link N^1 shown in Fig. 3.

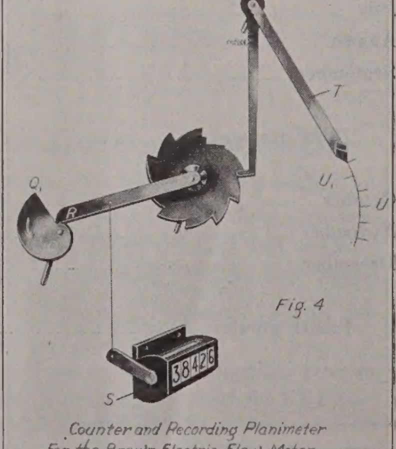
The angular relation between the uniform rotation of sector K and the rocking motion of arm N is an almost exact reproduction of the square root law through a large portion of the downward motion of arm N and a slight departure from the exact relation desired is taken care of by the shape of tripping blade O. A roller on the end of arm N passes across tripping blade O, which is very thin, and holds O fast against a plate while latch L^1 is being tripped.



Mechanism Reproducing Square Root Law in Brown Electric Flow Meter

When roller L has turned through a definite number of revolutions a pawl is released which thereupon engages with a toothed pinion of the chart-driving gear train. This causes a cam Q (Fig. 4) to make one complete revolution after the pawl is released and the cam then remains at rest until the roller again completes the proper number of revolutions.

Each time the cam arm falls the recording planimeter pen T makes a jog U in its record line, every tenth jog U^1 being in the opposite direction to facilitate counting when desired. The five-figured integrator dial S can be read at any given hour or hours of the day.



Counter and Recording Planimeter For the Brown Electric Flow Meter

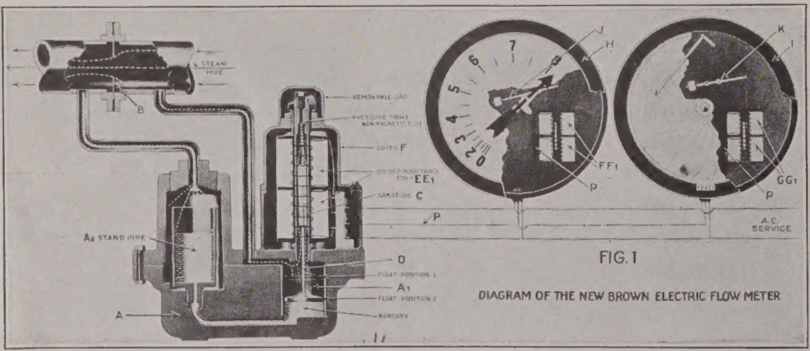
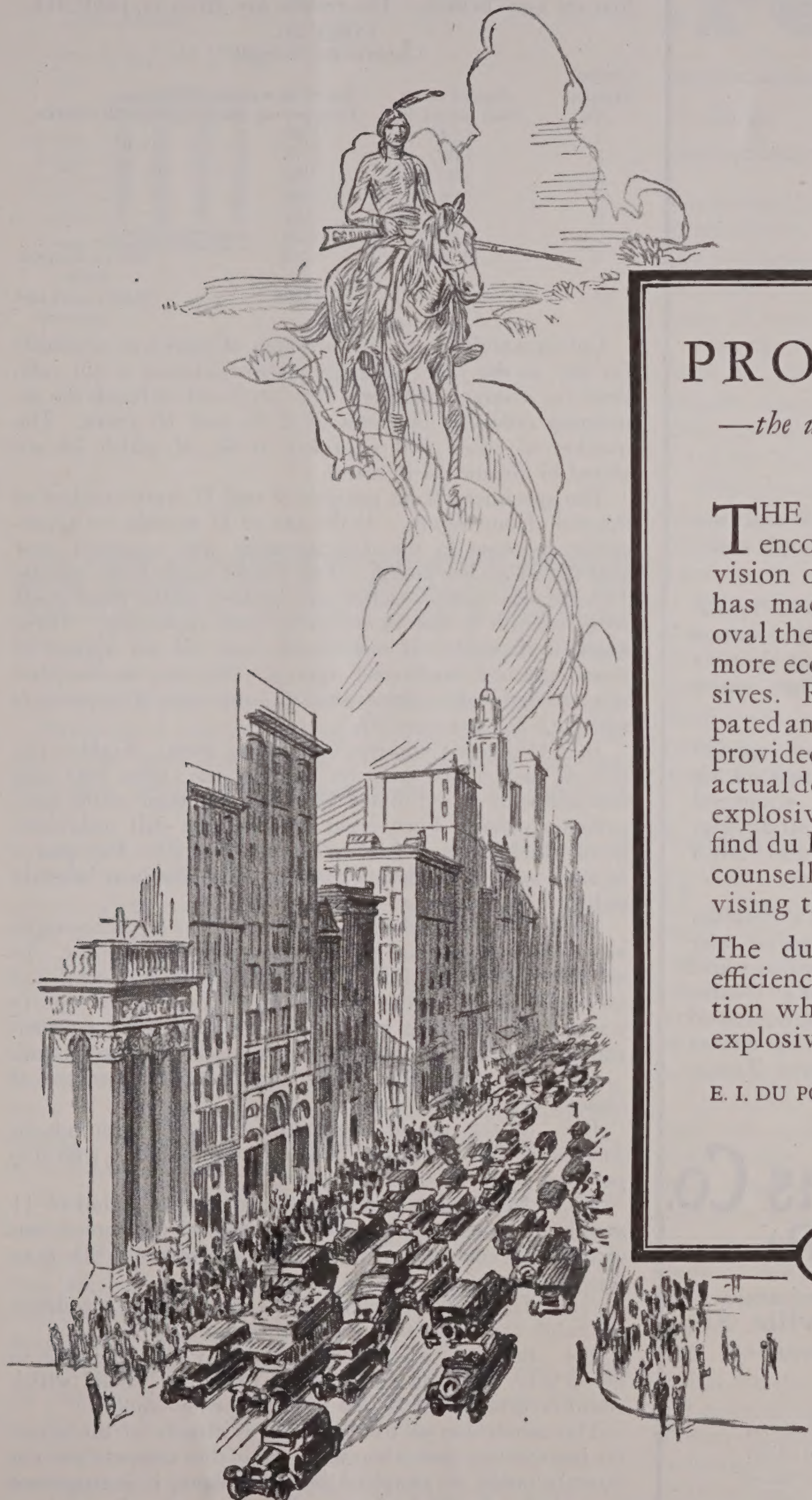


FIG. 1

DIAGRAM OF THE NEW BROWN ELECTRIC FLOW METER

MAKERS OF POWDERS SINCE 1802



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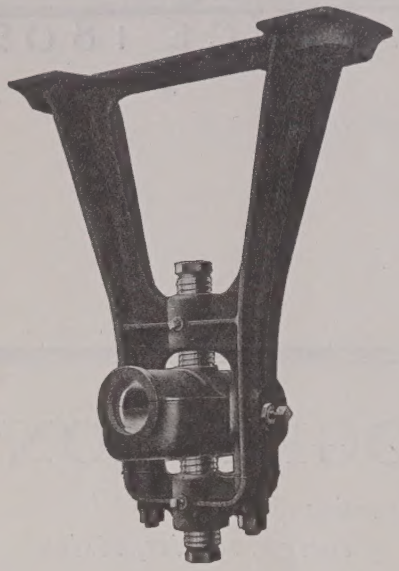

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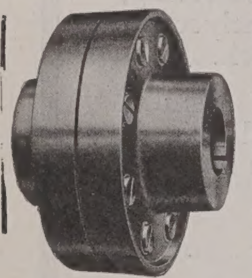

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High Sulphur Content in Portland Cement

(Concluded from page 102)

Chase), 4 parts quartzite (from Nuneaton), and was cast into 4-in. cubes and 4½-in. diameter cylinders. Half of these cubes were stored in air in a dry room, and the other half in water. At the end of 11 months the blocks of the first set were broken. The results are given in Table III.

TABLE III.
Compressive Strength

Cement Sample No.	Stored in air Tons per sq. in.	Stored in water Tons per sq. in.	Remarks
1	1.14	1.89	—
2	1.04	1.73	—
3	1.23	1.60	—
4	1.06	1.60	—
5	1.15	1.54	—
7	0.99	1.80	—
9	0.74	1.44	Shows distinct cracks.
11	0.71	0.297	Badly split and cracked

Unfortunately only one specimen of each was available for test, as the water shortage accommodation is not sufficient for a larger number. It is proposed to break the remaining cubes at intervals of 2, 5, and 10 years. The number of cubes still unbroken is 48, of which 24 are stored in air and 24 in water.

The specimens from samples 9 and 11 were cracked at the end of one month. At the age of 11 months no appreciable increase in the disintegration was apparent over that found at one month. The blocks made from sample 11 were very badly cracked and broken, whilst those made from sample 9 had only cracks just appearing. These again were visible at one month, and did not appear to have increased on further ageing. Decrease in compressive strength takes place when 6-7 per cent of gypsum is added (5-5½ per cent SO_3).

(e) Concrete Cylinders Containing Steel.—Eight cylinders of each of the mixtures used for the cubes were also cast and were stored under the same conditions as the compression cubes. Forty-eight of these are still unbroken, 24 of which are stored in water and 24 in air. Two pieces of steel were embedded in each cylinder. One was brightly polished and the other one was rusted.

After an interval of 11 months a cylinder of each sample was broken open, and the steel bars were examined. In no case was it possible to say that definite rusting had taken place due to the action of the concrete, or due to water and air getting into the concrete. Slight brownish-yellow skins and occasionally rust markings were found.

(i) High percentages of gypsum reduce the strength of cement, cement mortar and concrete.

(ii) At the end of one month concretes with cement containing over 6 per cent SO_3 were cracked, and with 6½ per cent SO_3 were badly cracked.

(iii) No obvious disintegration during a period of 11 months was observable on any samples of cement or concrete with a cement having a lower percentage of SO_3 than 6 per cent.

(iv) The Le Chatelier test for soundness fails to detect probable unsoundness due to high gypsum-content.

(v) In none of the samples used was it possible to detect any effect on steel, either bright or rusted which could be directly attributed to the gypsum content.

The conclusion as to soundness is clearly of the greatest importance, and when analyses of the cements are not directly made, or supplied by the makers, it is suggested that blocks should be kept under observation for at least one month. If these do not show signs of cracking after that period, there will probably be little fear of cracks developing later.

—*Canadian Engineer.*